MASTER OF SCIENCE
IN
ENGINEERING ACOUSTICS

ANALYSIS OF ENVIRONMENTAL INFLUENCES ON BROADBAND EXPLOSIVE TRANSMISSION LOSS SPECTRA NEAR THE MID ATLANTIC BIGHT

Dominic Carino-Major, Canadian Air Force
Adv. B.A., University of Manitoba, 1990
Master of Science in Engineering Acoustics-September 1999
Advisor: Kevin B. Smith, Department of Physics
Second Reader: LCDR Mitch Shipley, USN, Department of Physics

Under the sponsorship of the Office of Naval Research (ONR), an integrated acoustic and oceanographic field experiment was conducted jointly by the Naval Postgraduate School (NPS), the Woods Hole Oceanographic Institution (WHOI), and the University of Rhode Island in the Middle Atlantic Bight (MAB) to study the propagation of sound from the continental slope onto the continental shelf. The primary goal of this thesis is to examine the influence of environmental factors on broadband transmission loss (TL) spectra near the shelf break by analyzing the power spectral density of Signal Underwater Sound (SUS) transmissions. Measured broadband spectra are compared to numerical solutions in an attempt to determine which environmental factors dominate the TL structure. Results of such analysis are considered in the context of optimal frequencies of propagation for the MAB region.

DoD KEY TECHNOLOGY AREA: Modeling and Simulation

KEYWORDS: Broadband Transmission Loss (TL), Signal Underwater Sound (SUS), Measured Broadband Spectra

A MODAL APPROXIMATION FOR THE MUTUAL RADIATION IMPEDANCE FOR SPHERICAL SOURCES AND ACOUSTIC WAVE SCATTERING USING AN IMPROVED ATILA FINITE ELEMENT CODE

Joseph L. Day-DoD Civilian
B.S., University of Texas, El Paso, 1990
Master of Science in Engineering Acoustics-September 1999
Advisors: Clyde L. Scandrett, Department of Mathematics
Steven R. Baker, Department of Physics

A modal approximation for the self and mutual radiation impedances has been derived for arrays of spherical transducers with small *ka* values, where *ka* is the acoustic wave number multiplied by the radius of the sphere. This is termed "Modal Pritchard" approximation, as it is related to the so-called Pritchard approximation, often employed to calculate mutual radiation impedances. The utility of the approximate mutual radiation impedance expression for three two-body problems (monopoles, aligned dipoles, and aligned-linear quadrupoles) was investigated. For these cases, approximate values were found to be in good agreement with those obtained using a full Spherical Addition Theorem calculation, and are an improvement over the simple Pritchard approximation. Additionally, the mutual radiation impedance expression in one particular three-body problem was investigated. Because of the Modal Pritchard

approximation's inability to correctly handle scattering, using the full Spherical Addition Theorem calculation is recommended when scattering is important.

Finally, the use of a new finite element mesh to calculate the T-matrix for a given transducer was investigated. The T-matrix relates the incident and scattered waves for a single transducer, in an orthogonal (spherical harmonic) basis set. The monopole element showed an increase in error, while some improvements in the higher-order diagonal elements were observed. Off-diagonal elements, which should be zero for a spherical scatter, were satisfactorily small in most cases. Although the results were less than favorable, the ability to streamline the T-matrix calculation while providing a new method of examining the off-diagonal elements was achieved.

DoD KEY TECHNOLOGY AREAS: Sensors, Manufacturing Science and Technology (MS&T), Modeling and Simulation

KEYWORDS: ATILA-Finite Element Code, Mutual and Self Radiation Impedance, Normal Mode Spherical Harmonics